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Hutchins State Jail

Study Of
Indoor Climate Control Modifications

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1.0 Executive Summary

The Trak Engineering, Inc. and PDG Architects (TRAK/PDG) Team was tasked with drafting a construction management plan for the air conditioning of the Hutchins State Jail. Therefore the focus of this report is the 10 building complex located in Hutchins, Texas. The dormitories are heated and ventilated to provide basic thermal comfort for the occupants and TDCJ supervisory personnel. To properly evaluate the solution we have reviewed the applicable codes and standards, analyzed indoor and outdoor climate data, reviewed record drawings of the facilities, and interviewed staff personnel. Based on the results of those preparatory tasks the team has determined the general means and methods of further improving indoor thermal comfort, taking into account technical constraints, the capacity of existing utility infrastructure, the condition of the building envelope, operational, maintenance, and security parameters, population management during construction and finally potential cost.

Achieving "indoor thermal comfort" is an engineering design term that basically means conditioning the air supplied to a space to meet some accepted standard or code. To the average occupant it means turn on the A/C if it's hot or the heat if it's cold depending on that occupants' perception of comfort. The observed dorm facilities are currently able to condition air supplied to a space by heating it. Our approach, and the focus of this study, is to rely on ASHRAE's Standard 55-2013. When the study describes meeting the parameters of a "comfort zone" we mean applying some means of chilling the air and reducing the humidity to achieve compliance with ASHRAE's Standard 55-2013. This issue is discussed further in Section 3.1.

The primary challenge for TDCJ is the control of indoor thermal comfort conditions during those months that are the hottest, June through September. The Hutchins State Jail that is the subject of this study lies on the flat prairie just southwest of Dallas in the hot humid area of the Trinity River Valley. The Hutchins State Jail presents a significant challenge to maintaining indoor thermal comfort conditions during the hot summer months with humidity being a negative factor in the design of a comfort control systems.

The determination of climate control assigned to this particular unit is limited by the scope of the team's efforts to survey the facilities. Onsite visits were not comprehensive or exhaustive, measurements of air volumes were not taken and the operational status of equipment was observed not measured. However, temperature and humidity information was collected over a 45 day period using dataloggers to record temperature and relative humidity in the dormitories.

The means and methods for climate control in this particular unit will be unique to this unit. While certain types of systems may be recommended for more than one unit, each unit must be considered separately as to how a particular system is selected for the local climate, building type, and operations. Maximum flexibility must be afforded to future design teams as they determine the best combination of thermal condition mitigation, building envelope upgrades, and utility infrastructure improvements.

The Trak/PDG Team determined that it is technologically possible to modify the building envelope, add mechanical equipment, upgrade utilities, and control the operation of equipment to further improve

indoor thermal comfort at the Hutchins State Jail. The total opinion of probable cost to retrofit the Hutchins State Jail with air conditioning is estimated at $79,113,899 See Appendix "A", C1.01.

The costs are summarized below:

Modify and upgrade the building envelopes of the four original 1981 dormitories and Trusty Camp:	$61,854,929
Purchase and installation of mechanical HVAC components:	$13,627,205
Upgrade electrical system:	$1,587,684
Structural additions to support new HVAC equipment:	$2,044,081
Project Construction Cost Total:	**$79,113,899**

In addition, there will be an increase in ongoing operational costs. The annual cost to operate the new HVAC system is estimated at $316,422. It will be necessary to employ three full-time employees to maintain and repair the new system, at an annual cost of $111,819. The total annual increase in operational cost is estimated at $428,241. (See Appendix "A", C1.02). Not included in the construction cost total are the additional electrical capacity upgrades that may be required to the site to serve the new HVAC system. Costs for modifications or replacement of the existing diesel generator, water wells, or well pumping capacity for the chilled water make up are also not included.

Another item not included in the construction cost total is the cost of housing displaced offenders during various phases of the construction. A construction management plan will be impossible to produce if the population shifting problem cannot be managed.

The minimum estimated construction duration including logistics is anticipated to be approximately eighteen (18) months.

2.0 Introduction

2.1 Objective of the Study

This study consists of an analysis of how to further improve the indoor thermal environment at the Hutchins State Jail given the constraints in place. Those constraints include but are not limited to operational, technical, scheduling, and costs.

The focus of the narrative presented in this report document is primarily concerned with the constraint of technical feasibility. The other constraints are no less significant. However, they must be determined by the interaction of a larger group of stakeholders from the administrative, operational and legal divisions of the TDCJ.

2.2 Overview of Existing Conditions

Thermal comfort has always been a consideration in the design and construction of adult detention facilities. The Hutchins State Jail was designed to be heated and ventilated. It was also constructed and subsequently modified to improve heating and ventilation capabilities. Originally, ventilation was planned to be a of active elements only as the windows in the dormitories are not operable. For summer cooling louvers allowed fresh air to be drawn in using fan powered exhaust ventilators and the supply air handlers. Winter heating required that minimum exhaust ventilators and the gas fired air handlers to warm the air. Smoke supply air fans and smoke exhaust fans in each dorm unit were installed for emergencies but are now used for general ventilation. Auxiliary fans units are installed to further improve the movement of air. Typically, system wide, air conditioning was provided to common areas, administrative offices, infirmaries, and educational areas. Consequently the envelope for dormitory buildings at each facility was designed for an interior climate control system that did not include air conditioning.

The Hutchins State Jail is based on a pre-engineered metal building design. All of the buildings are single level. The building envelope for a metal building is an efficient means of construction but is seriously deficient when it comes to mitigating the effect of radiant heat transfer and controlling the movement of water vapor.

3.0 Codes & Standards

3.1 What are the Standards Used in the Analysis?

The professional design community relies on codes and standards in order to ensure the health and safety of the public and/or occupants of a building. Additionally, a consistent approach to the design and construction of similar facilities provides a logical basis for planning, documenting, and constructing a particular type of facility under varying climatic and geographic conditions. When considering which standard to use for this study the Trak/PDG Team compared ASHRAE 55 against other criteria such as the heat index (HI) or arbitrary temperature limitations.

What is ASHRAE 55? The American National Standard Institute (ANSI) is a national voluntary consensus standard developed under the auspices of the American Society of Heating, Refrigeration, & Air-Conditioning Engineers (ASHRAE). Consensus is defined by the American National Standards Institute

(ANSI) of which ASHRAE is a member. The purpose of ANSI/ASHRAE 55-2013 is to specify the combinations of indoor thermal environmental factors that will produce thermal environmental conditions acceptable to a majority of the occupants within the space.[1] The environmental factors addressed in the standard are temperature, thermal radiation, humidity, and air speed; the personal factors are those of activity and clothing.

The Heat Index is an index (a number) that combines temperature and relative humidity in an attempt to determine the human-perceived equivalent temperature, or how hot it feels. The Heat Index is based on subjective measurements and is only meaningful above 77ºF and 40% RH. It is primarily used to describe outdoor conditions under which the body's ability to cool itself is compromised by an increase in the temperature and humidity levels. The index is derived using data collected outdoors in the shade and in a light wind. The Heat Index does not take into account the amplifying or mitigating effects the building envelope or enclosure has on the indoor thermal comfort of an occupied space.

Using an arbitrary temperature such as 88ºF removes useful factors from consideration such as wind speed and low relative humidity. This could easily force a facility to cool the air for a dormitory when more energy efficient means are available. This can be seen in the evolution of the ACA Guide for Adult Local Detention Facilities where the following is noted "New ACA Standards move toward a performance based criteria, comfort zones, replacing the temperature range that used to be used in the Second Edition".[2] Additionally, the ACA Standards for Adult Correctional Institutions, Fourth Edition, under Section 4-4153 states that "Temperatures in indoor living and work areas are appropriate to the summer and winter comfort zones".[3] Further comment directs temperature and humidity levels to be capable of being mechanically raised or lowered to an "acceptable comfort level". The movement is clearly from a specified limit approach for climate control to a performance based approach that allows for a flexible set of parameters for design and operation of a correctional facility.

3.2 Applicable Codes

The State of Texas has adopted by Statute or Administrative Code various building codes that apply to the design, addition to, or alteration of buildings in the State. The primary Codes considered applicable to this study are as follows:

International Fire Code (IFC), adopted by Texas Local Government Code § 233.062

International Energy Conservation Code (IECC), adopted by Texas Health & Safety Code § 388.003, 16 Texas Administrative Code § 70.100, and 34 Texas Administrative Code § 19.32

International Building Code (IBC), adopted by Texas Local Government Code § 214.216 and 16 Texas Administrative Code § 70.100

[1] (ASHRAE STANDARD 55, 2013), Page 2
[2] (Miller, 1993)
[3] (Standards For Adult Correctional Institutions, 2006)

International Mechanical Code (IMC), adopted by Texas Occupations Code § 1302.101 and 16 Texas Administrative Code § 70.100

ASHRAE 62.1-2010 - Ventilation for Acceptable Indoor Air Quality, adopted by the **IBC** as part of the code.

Of particular consequence is a requirement in the IBC Chapter 1301.1.1 that all buildings shall be designed in accordance with the IECC. When applying the requirements of the IECC to the analysis of air conditioning an existing detention facility the following is pertinent: "**C101.4.5 Change in space conditioning"** (in accordance with the IECC). Any non-conditioned space that is altered to become *conditioned space* shall be required to be brought into full compliance with this code. This simply means that the building thermal envelope, i.e. the walls and roof of the facility along with any openings, has to meet current requirements for insulation and thermal radiation. Through the State Energy Conservation Office, Texas is committed to achieve 90 percent compliance with the 2009 International Energy Conservation Code by 2017.

The engineers and architects registered by the State of Texas are constrained by virtue of their state licensure to carefully adhere to all state adopted codes. Any deviation or variance from the code can only be granted by the "Authority Having Jurisdiction (AHJ)". Absent a variance, if a building is changed from "non-conditioned" to "conditioned" the building envelope must be brought into compliance with the Energy Code.

3.3 ABBREVIATIONS:

1. AFF - Above Finished Floor
2. AHJ - Authority Having Jurisdiction
3. AHU - Air Handling Unit
4. AIC - Amperes Interrupted Current
5. ANSI - American National Standards Institute
6. ARI - Air-conditioning and Refrigeration Institute
7. ASTM - American Society for Testing and Materials
8. ATS - Automatic Transfer Switch
9. ASHRAE - American Society of Refrigeration Air-conditioning Engineers
10. BAS - Building Automation System
11. BTU - British Thermal Units
12. CFM - Cubic Feet Per Minute
13. CHP - Chilled Water Pump
14. DA - Dry Air
15. DB - Dry Bulb
16. DDC - Direct Digital Control
17. DX - Direct Expansion
18. EMT - Electrical Metallic Tubing
19. FM - Factory Mutual
20. FPM - Feet Per Minute
21. GPM - Gallons Per Minute
22. HAP - Hourly Analysis Program

23. HP - Horse Power
24. HR - Hour
25. HVAC - Heating Ventilation Air Conditioning
26. H&V - Heating and Ventilation
27. IEEE - Institute of Electrical and Electronics Engineers
28. KVA - Kilo Volt Amps or 1,000 Volt Amps
29. KW - Kilo Watts or 1,000 Watts
30. MBH - 1000 BTU/s per Hour
31. NEMA - National Electrical Manufacturer's Association
32. NFPA - National Fire Protection Association
33. NRTL - Nationally Recognized Testing Laboratories (UL or FM)
34. PF - Power Factor
35. Trak - Trak Engineering, Inc.
36. Ton- A unit for refrigeration cooling capacity is equal to 12,000 BTU/hr
37. UL - Underwriters Laboratories
38. UPS - Uninterrupted Power Source
39. VAV - Variable Air Volume
40. VFD - Variable Frequency Drive

3.4 Non-Conditioned VS. Conditioned

Two definitions found in Section C202 of the IECC are pertinent to the discussion of non-conditioned versus conditioned space. First, a *building thermal envelope* is defined as “The basement walls, exterior walls, floor, roof, and any other building elements that enclose conditioned space or provides a boundary between conditioned space and exempt or unconditioned space”.[4] Second, *conditioned space* is defined as “An area or room within a building being heated or cooled, containing uninsulated ducts, or with a fixed opening directly into an adjacent conditioned space".[5]

Changing non-conditioned to conditioned space by whatever means requires that the energy efficiency of the building thermal envelope be addressed. If the code requires that a portion of the building envelope meet a certain R-value, then a portion of the scope and cost of conditioning a space must be dedicated to meeting that R-value. That will be extended to the entire building envelope. The cost of meeting those requirements must be accounted for in the determination of feasibility all the way up to the final design of the facility upgrades.

4.0 Hutchins State Jail - Dallas, Texas

4.1 Existing Conditions – The Hutchins State Jail is located at 1500 E Langdon Rd, Dallas, TX 75241, Texas 11.4 miles south of Dallas at the intersection of IH-45 and IH-20 in Dallas County. The construction documents produced for the original facility by Aguirre Engineers and are dated August 1994. The unit was brought on line in 1995. The facility employs 399 staff and houses a maximum of 2,276 offenders.

The complex consists of ten primary single story buildings of which three are double dormitory units and three are single dormitory units. The remaining four buildings are for administration, dining, educational, medical, visitation, and other support functions. The buildings are oriented primarily in an east west direction with a central open circulation spine. Dormitory pods are divided into four sections with a central picket. Each section houses approximately 52 offenders in bunk beds with a shower/toilet module in each section.

4.1.1 Main Dormitory Building Envelope – Hutchins is designed and constructed on a pre-engineered metal building format. Dormitory buildings containing eight pods are 120 feet by 300 feet. Single dormitory buildings containing four pods are 120 feet by 150 feet. Larger buildings are divided into 12-25 foot bays with an eave height of 12 feet and a roof slope of 2/12. The main rigid frames are 120 feet with a column in the center. End walls are bearing with columns at 20 feet on center. Single dormitories are half that size.

The exterior wall system consists of metal panels fastened to 8 inch wall girts framed between the rigid frames. In the dormitory a pre-manufactured metal insulated wall panel system is attached to the inside leg of the girt. The record drawings indicate 6 inch batt insulation was placed against the inside face of the outside wall panel. When the basic value of the 6 inch batt insulation and the wall panel are combined the R-value is approximately 20 to 25. However, due

[4] (International Energy Conservation Code, 2012)
[5] (International Energy Conservation Code, 2012)

to the significant amount of thermal bridging inherent in a metal building wall system the R-value of the assembly is likely to be 7 or less. The vinyl faced insulation under the roof panel will have an assembly R-value of less than 4.

If the dormitories are to be air conditioned the roof and wall panels will have to be replaced to meet the energy code. At a minimum the wall panels will have to be replaced with a 2 inch insulated metal panel fastened to the outside leg of the girt system. The existing metal panels and vinyl faced insulation on the roof will have to be replaced with a 3 inch insulated metal panel. Consideration should be given to using a 3 inch panel on the walls and a 4 inch panel on the roof for greater energy efficiency at minimal additional cost. It is likely the existing metal panels that form the inside surface of the outside wall can remain in place. A study should be conducted to determine if the space between the inside and outside panels needs to be ventilated. The various appurtenances that contribute to the outside wall system such as windows, doors, and louvers, should be evaluated for reuse versus replacement.

4.2 Mechanical Systems

4.2.1 General

The focus of this report is to concentrate on inmate housing area Heating & Ventilation (H&V) systems in buildings A, B, C, D, E and F as shown in the figure 1 below. All inmate housing buildings are similar. Buildings D, E, and F are individual stand alone buildings with four similar housing quadrants or units. Buildings A, B, and C are simply two buildings of D, E, and F put together with eight housing units . Incidences referenced in this report pertain to heat related deaths.

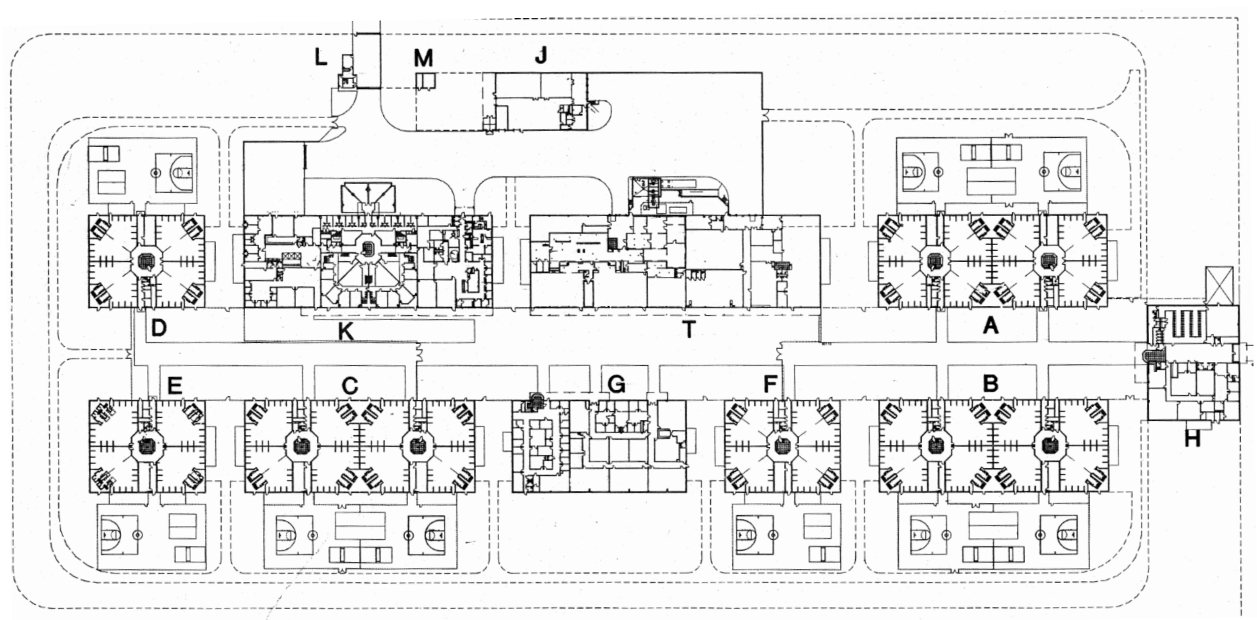

Figure 1 Site Plan

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The other areas such as the office administration, medical, kitchen, dining, laundry, recreational, commissary, maintenance, utility areas, etc, are areas not addressed in this report. These are areas where either air conditioning exists, are not occupied, are temporary transient locations, or are areas where incidences have not occurred.

4.2.2 - Existing System

The inmate housing H&V systems at the Hutchins State Jail are similar in all housing buildings listed above. The ventilation in the system is achieved by outdoor air supply fan provided by a H&V Packaged Unit (H&VPU)and several exhaust fans. There is a dedicated H&VPU serving two housing quadrants. The H&VPU are constant volume air systems which provide heating and outdoor air ventilation. The existing packaged H&VPU are a self contained unit that is "Packaged" from the factory consisting of a supply fan, motor, air filters, gas heating furnace, outdoor air intake dampers, and controls in a single insulated casing. These units are dropped in place connected to ductwork and an single electrical connection and ready to operate.

The H&VPU consists of an economizer cycle which means that it can introduce 100% outdoor air during the summer mode. When operating in the summer mode a large exhaust fan operates located on the roof of the inmate quadrant and exhausts approximately 100% of the supply air provided by the H&VPU. During the heating mode a small exhaust fan exhausts air from the return air plenum approximately the amount of a minimum percentage of outdoor air mixed with supply air that is introduced by the H&VPU.

mode a small exhaust fan exhausts air from the return air plenum approximately the amount of a minimum percentage of outdoor air mixed with supply air that is introduced by the H&VPU.

Each inmate quadrant consists of a toilet and shower area with dedicated continuous exhaust.

4.2.3 - Proposed System

The new proposed system should be selected for a higher duty better suited for 24 hour, 365 day operation with a 20 to 25 year service life expectancy per ASHRAE 2011 HVAC Applications Handbook. New water based air handlers with chilled and hot water coils are proposed with multi fan arrangements in the event of motor failure of the fan. A chiller and heating hot water boiler plant is proposed to efficiently provide reliable cooling and heating to the air handlers. Chilled and hot water distribution piping would be required and connected to new air handlers and to piping flanges of the plant.

Refer to Appendix "A" of this document for a proposed Mechanical drawings

1. Mechanical Plan - Hutchins State Jail M1.01

Below is a synopsis of the air handler and chiller boiler plant which are common systems in the industry which is depicted in the mechanical plans in Appendix "A".

4.2.3.1 Air Systems - The supply air systems will consist of one (1) Air Handling Unit serving two quadrants replacing the existing H&VPU system serving the inmate housing. These areas shall be exhausted with no return air back to the units. The air handler shall be mounted in the same location as the H&VPU. In order to reduce operating costs the new AHUs should be provide with an energy recovery device.

It is recommended that the AHU's are semi-custom air handling units equivalent to manufacturers such as Haakon, Climate Craft or Temptrol. The units will consist of an air mixing intake plenum with economizer cycle, 30% efficient pre-filters, 12" access section, possible energy recovery wheel (or zero leakage air to air heat exchanger), 12" access section, supplemental steam or hot water pre-heat coil, 12" access section, cooling coil, supply fan section, 65% final filters, and discharge plenum. The supply fan section should preferably contain a fan wall with a minimum of four (4) supply fans and motors for redundancy. That is if one fan and motor fails the unit shall still have 75% of its total air capacity.

The unit will be 4" insulated, solid double wall thermally broken construction in all sections. Sound attenuators will be provided in the discharge ductwork or as an integral part of the unit as needed to meet the NC ratings. The units will be sized for a maximum filter and coil face velocity of 475 FPM.

The supply air fans shall operate on variable frequency drives (VFD) to control airflow and building pressurization. Fans VFD and will respond to the ductwork static pressure sensor to assist in maintaining the lab supply airflow quantity for the proper pressurization relationship.

The units will be mounted on a 12" high factory curb.

Supply and exhaust air will be distributed thru medium pressure class with welded seams and joints and security bars in the ductwork imbedded into the wall structure. The Ductwork shall have external duct insulation that meets the energy code and ASHRAE 90.1. To prevent damage of ductwork insulation by prisoners, a double walled insulated duct system (with insulation sandwiched between two metal ducts) shall be utilized where inmates may have contact with ductwork.

Common Dayroom/Sleeping Quarters

Existing Duct Chase for New Ducts

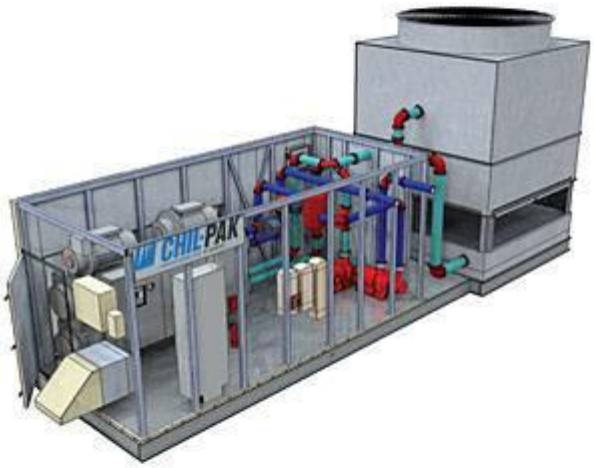
Ductwork distribution is easily accommodated into the space via an existing duct chase. Supply can discharge into the common dayroom/sleeping area and be exhausted directly out through new or existing exhaust fans. Toilet rooms and showers also common to the dayroom/sleeping quarters will have continuous exhaust.

In addition to the supply air from the air handler, a large volume mixing fan is recommended for mixing any stratified air in the day room which is a common open space to each inmate sleeping area. These fans are already used throughout several correctional TDCJ facilities such as the one pictured below. Manufacturers are MacroAir, Kelly Fans, and Big Ass Fan Company.

4.2.3.2 Water System - A Packaged Chilled water and Hot water boiler plant that sits outdoors on a concrete equipment pad is proposed. The Plant shall be factory assembled indoors in a controlled environment. The system shall be factory wired, piped, painted, and tested. The system shall be complete with centrifugal chillers, boilers, pumps (chilled, condenser, and hot water pumps), pipes, valves, fittings, hangers, controls, buffer tank, cooling tower, and electrical system. The system shall be housed in a water tight, ventilated, and heated enclosure with a single point electrical system (lighting, panels, transformers, starters, disconnects, wiring, and MCC) and chilled water and hot water supply and return line connection flanges.

The advantage of this factory assembled plant system versus one constructed on site is that it does not take up any additional space in the existing building, saves construction time, is assembled indoors with a highly supervised quality controlled program in a clean quality controlled environment, and is one complete tested plant with guaranteed performance and efficiency. The manufactured plant also shortens the project schedule, has a single point of responsibility, reduces risk, and is portable to another site. The plant shall comply with all ASHRAE 189.1 requirements and exceeds ASHRAE 90.1.

Manufacturers shall include Epsilon Industries, Chil-Pak, Systecon Inc., and Armstrong.



<u>Example of a packaged Factory Assembled Chilled Water Plant.</u>

4.2.3.2.1 <u>Chilled Water System Requirements</u>

Chilled water shall be provided by a new chiller plant as described above.

The peak chilled water cooling load for the dorm buildings is estimated to be **1,100** tons which is required to serve the new AHUs. Assuming that the chilled water supply temperature of 42 Deg F and a return temperature of 54 Deg F the total chilled water flow required through new proposed secondary building pumps is **2,000** GPM.

It is recommended that three (3) end suction or inline chilled water building circulation pumps "secondary pumps" (CHP-1, 2, & 3) be provided. Each pump shall provide 1/2 of the total GPM required. Pumps shall have premium efficiency motors. Two (2) pumps shall be capable of carrying the total chilled water load and one (1) pump shall be a standby pump in a lead/lag arrangement. The chilled water pumps shall operate a variable speed controlled by a variable frequency drive controlled by a pressure transmitter. Only two (2) pumps shall run at any given time as one (1) pump shall be used for redundancy. Acceptable chilled and condenser water pump manufacturers shall be Aurora, Paco, Armstrong, and Grundfos.

Heat shall be rejected from the system using a cooling tower fed from two condenser water pumps totaling **3,300** GPM. A chemical pot feeder shall be provided adjacent to one of the chilled water pumps for water treatment. Chilled and condenser water piping in the plant and to the air handling units shall be schedule 40 black steel piping from. Underground piping shall be pre-insulated with schedule 40 black steel carrier piping, polyisocyanurate foam insulation

and a HDPE outer protective casing as manufactured by Insul-Tek®Piping Systems Inc., Thermacor Process Inc., or Perma-Pipe® Systems.

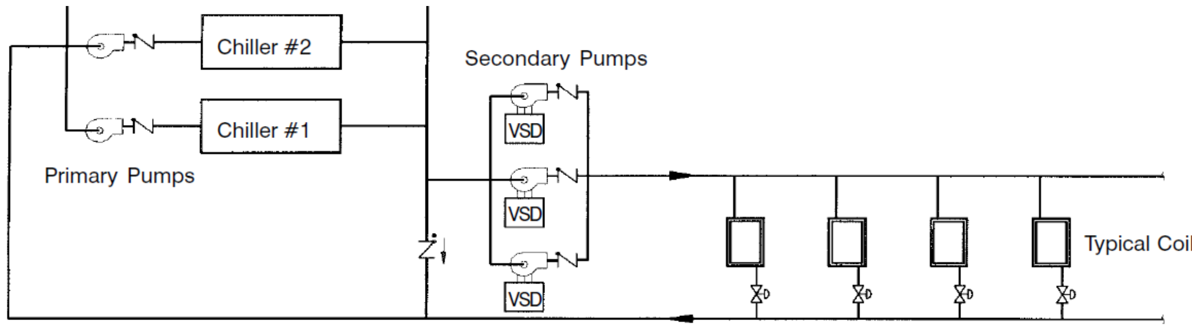


Figure 2 - Proposed System With Secondary Pumps

Two-way control valves shall be used at each air handling unit to allow variable flow thru the system. A two way bypass loop at the end of the line shall be provided to allow the minimum flow required through one pump. A chilled water loop expansion tank and air separator shall be provided equal to Bell & Gossett Rolairtrol.

4.2.3.2.2 Heating Water System Requirements

The total dorm buildings hot heating load is estimated to be **6,000** MBH. The hot water temperature shall be 190 Deg F hot water supply temperature and 160 Deg F return. The total hot water flow is **400** GPM.

The same pump arrangement as the chilled water pump is recommended with the hot water pumps. Three (3) end suction or inline hot water building circulation pumps "secondary pumps" (HWP-1, 2, & 3) are proposed to be provided. Each pump shall provide 1/2 of the total GPM required. Pumps shall have premium efficiency motors. Two-way control valves shall be used at each air handling unit to allow variable flow thru the system. Two (2) pumps shall be capable of carrying the total hot water load and one (1) pump shall be a standby pump in a lead/lag arrangement. The hot water pumps shall operate a variable speed controlled by a variable frequency drive controlled by a pressure transmitter. Only two (2) pumps shall run at any given time as one (1) pump shall be used for redundancy. Acceptable hot water pump manufacturers shall be Aurora, Paco, Armstrong, Grundfos.

A chemical pot feeder shall be provided adjacent to one of the heating water pumps for water treatment. A heating water loop expansion tank and air separator shall be provided equal to Bell & Gossett Rolairtrol.

Heating Hot water piping in the plant and to the air handling units shall be schedule 40 black steel piping from the plant to the underground piping. Underground piping shall be pre-insulated with schedule 40 black steel carrier piping, polyisocyanurate foam insulation and a

HDPE outer protective casing as manufactured by Insul-Tek®Piping Systems Inc., Thermacor Process Inc., or Perma-Pipe® Systems.

4.2.4 - Load Calculation

Summer outdoor design conditions have been selected based on the 0.4% dry bulb (db) and 0.4% wet bulb (wb) (not mean coincident) conditions listed in the latest ASHRAE Fundamentals Handbook for the project location. For 100% outside air units these values are recommended to minimize the number of hours per year that design conditions are exceeded.

Winter outdoor design conditions have been selected based on the 99.6% heating dry bulb conditions listed in the latest ASHRAE Fundamentals Handbook for the project location. For 100% outside air systems this value is recommended to minimize the number of hours per year that design conditions are exceeded.

The table below lists the recommended ambient design conditions from ASHRAE weather data located closest to the Hutchins Unit which is Dallas/Fort Work airport (Elevation 597 feet above sea level) in Dallas, Texas.

Outdoor Design Conditions Table

Season	Summer - Use ASHRAE 0.4% Columns (db & wb, not mean coincident wb)				Winter - Use ASHRAE 99.6% Temperature Column			
Criteria	° F db	° F wb	% RH	grains/ lb.da	° F db	° F wb	% RH	grains/ lb.da
Design Day	100	98	93.0	280	17	17	54	7

4.2.4.1 Indoor Design Conditions - The Indoor design conditions have been selected based on ASHRAE Standard 55 Thermal Environmental Conditions for Human Occupancy while maximizing energy efficiency and staying below the heat index of 88°F. Values used are based on the recommendations of the standard which accounts for the type of clothing worn (such as inmate jump suit, socks, and shoes = Clo of 0.53), air speed (21 to 40 FPM), temperature, humidity, and metabolic rate (inmates standing relaxed = Met of 1.2).

Indoor Design Conditions Table

Mode of Operation	Cooling				Heating			
Space Type	°F db		% RH	Heat Index	° F db		% RH	
Cell	80		40	80	72		n/a	
Cell Common Areas	80		40	80	72		n/a	
Cell Restroom/Showers	80		40	80	75		n/a	

Figure 3 below demonstrates that the proposed air conditioning dry bulb temperature and relative humidity for cooling complies with ASHRAE standard 55 for thermal comfort . Figure 4 shows the result of an on line calculator that also demonstrates compliance to ASHRAE Standard 55 at the metabolic activity rate of inmates standing and relaxed with the inmate clothed as described in the first paragraph of section 4.2.4.1 above.

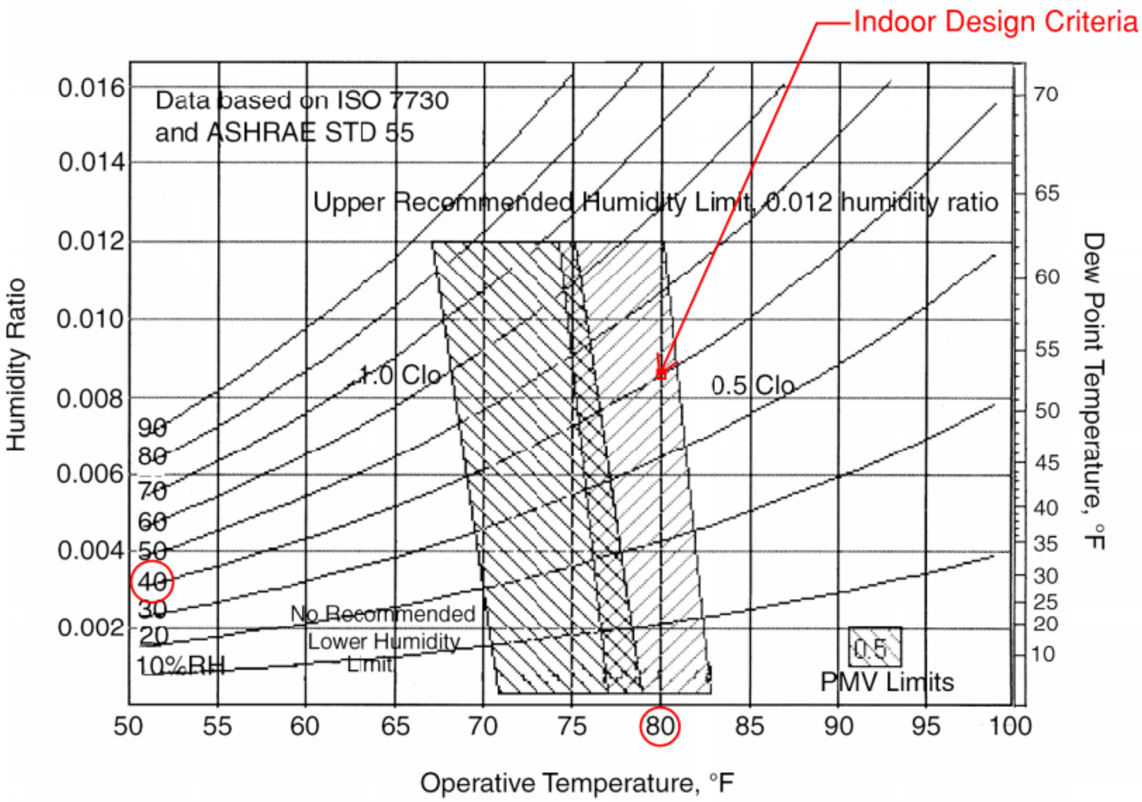


Figure 3

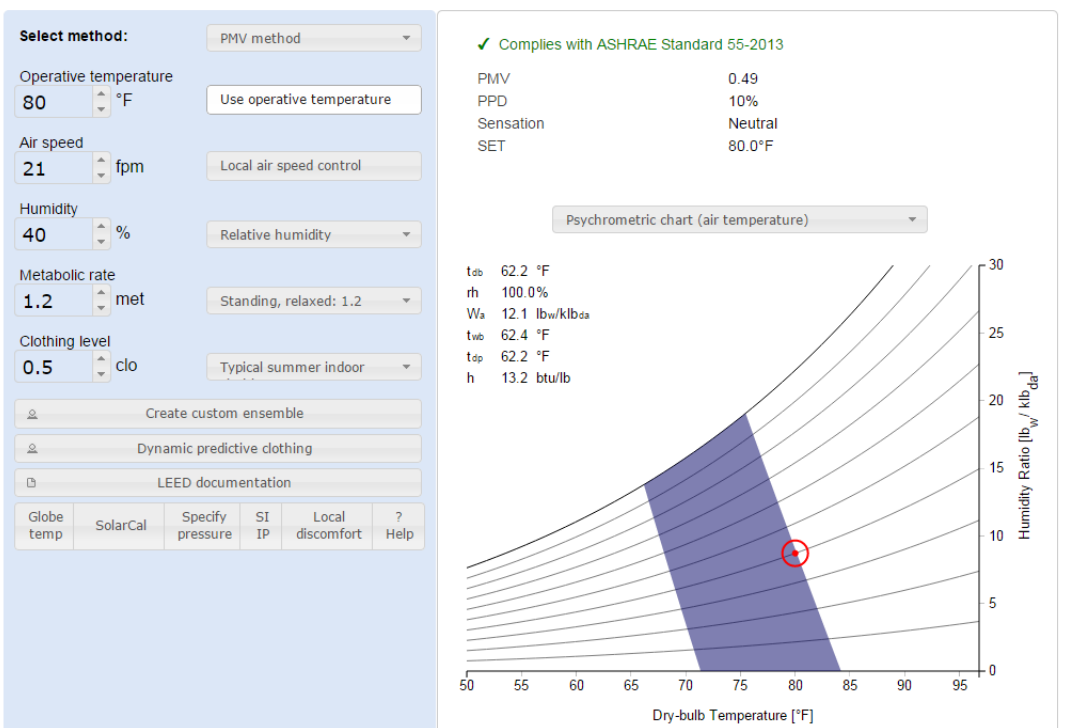


Figure 4

The indoor design conditions selected not only meets the ASHRAE 55 standard conditions but is also less than the arbitrary heat index value of 88°F.

4.2.5 - Minimum Ventilation Rates

Minimum ventilation rates used in calculations are based on the IBC and ASHRAE 62.1 2010 Table 6-1 see below:

TABLE 6-1 MINIMUM VENTILATION RATES IN BREATHING ZONE
(This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate R_p		Area Outdoor Air Rate R_a		Notes	Default Values: Occupant Density (see Note 4)	Default Values: Combined Outdoor Air Rate (see Note 5)		Air Class
	cfm/person	L/s·person	cfm/ft^2	L/s·m^2		#/1000 ft^2 or #/100 m^2	cfm/person	L/s·person	
Correctional Facilities									
Cell	5	2.5	0.12	0.6		25	10	4.9	2

However, since the cells have toilets in the same area, then the minimum exhaust rate shall be applied at the exhaust rate indicated in Table 6-4 of ASHRAE 62.1 2010 see below:

TABLE 6-4 Minimum Exhaust Rates

Occupancy Category	Exhaust Rate, cfm/unit	Exhaust Rate, cfm/ft^2	Notes	Exhaust Rate, L/s·unit	Exhaust Rate, L/s·m^2	Air Class
Arenas	–	0.50	B	–	–	1
Art classrooms	–	0.70		–	3.5	2
Auto repair rooms	–	1.50	A	–	7.5	2
Barber shops	–	0.50		–	2.5	2
Beauty and nail salons	–	0.60		–	3.0	2
Cells with toilet	–	1.00		–	5.0	2

Therefore, calculations were based on **1cfm/ft2** of ventilation supply air for sizing the air handlers, cooling, and heating equipment. In order to avoid or minimize infiltration of unconditioned outdoor air the conditioned supply air shall approximately equal the exhaust air. Avoiding infiltration of unconditioned outdoor air will minimize mold and mildew growth in the facility.

4.2.6 - Structural For Mechanical - Structural slab for the new chiller plant, boiler plant, and an air handler platforms will have to be designed and provided to properly support the new equipment. Ductwork and piping shall have supports which will be supported by the building structure or the ground on a footing and station which will need detail engineering, design and building structural analysis.

4.3 Electrical System

4.3.1 - Electrical Service and Distribution Design Criteria

4.3.1.1 General

1. Governing Codes Standards and Regulations:
   A. The following codes and standards will be used as part of the electrical design criteria for the project:
      1. Texas Building Code 2006 Edition
      2. Texas Fire Prevention Code 2006 Edition
      3. National Fire Protection Association (NFPA):
         a. NFPA 70-2011 Edition. National Electrical Code (NEC)
         b. NFPA 70E-2011 Edition. Standard for Electrical Safety in the Workplace
         c. NFPA 72-2007 Edition. National Fire Alarm Code
         d. NFPA 110-2005 Edition. Standard for Emergency and Standby Power Systems
      4. City Design and Construction Standards
      5. Institute of Electrical and Electronic Engineers (IEEE)
         a. IEEE-1547 Standard for Interconnecting Distributed Resources with Electric Power Systems.
         b. Construction Permitting: following the Authority Having Jurisdiction in the location of the jail for the construction of the Infrastructure Upgrade project.
         c. Provide complete electrical commissioning services to test electrical system functionality. Testing to include verification of all interconnection items as required by Utility company.

4.3.1.2 Main Electrical Service

1. General:

   Existing Installations:

   1. The existing electrical power supply for the facility consists of the following:
      a. Main 5 transformers and 5 emergency diesel generators supplying electrical power to all the 13 buildings of Hutchins unit.
      b. The distribution network is 13.8kV/480-277v and 480/208-120V, 3-phase, 4-wire Standby Diesel Generator, Cummins, rated 365KW, 456KVA at 0.8 PF, 549A connected to the Main Distribution Panel via ATS, GE, rated 800A.
      c. Transformer "TR-T" is 1500kVA working in conjunction with a emergency diesel generator "T" of 250kW @ 0.8 power factor and 400A MCB to supply power to buildings T, J, L & M.
      d. Transformer "TR-DK" is 1500kVA working in conjunction with a emergency diesel generator "DK" of 500kW @ 0.8 power factor and 750A MCB to supply power to buildings D & K.
      e. Transformer "TR-CE" is 750kVA working in conjunction with a emergency diesel generator "CE" of 500kW @ 0.8 power factor and 750A MCB to supply power to buildings C & E.
      f. Transformer "TR-FG" is 750kVA working in conjunction with a emergency diesel generator "FG", 400kW @ 0.8 power factor and 600A MCB to supply power to buildings F & G.
      g. Transformer "TR-HAB" is 1500kVA working in conjunction with a emergency diesel generator "HAB" of 800kW @ 0.8 power factor and 1200A MCB to supply power to buildings H, A & B.

   A. New Installations:
      1. Based on the existing electrical network, we are confident to say it will not be adequate to supply the new mechanical loads and accordingly we propose providing a new facility. The

power supply is estimated to be of 2500 Amp bus rating and breaker via a new pad mounted oil filled transformer 1500 KVA, 12470/480-277V, Delta/Wye configuration to feed the new mechanical loads for air-conditioning and heating.

2. The new facility will consist of, but not limited to, a new transformer, a generator rated 365KW, 456KVA at 0.8 PF, 800A ATS, and main distribution panel complete with the appropriate VFD's, controllers, cable sizes and raceways *(please refer to attached drawings in appendix "A")*.

4.3.1.3 Main Electrical Distribution Equipment

1. General:

   The main electrical distribution equipment shall consist of draw-out switchgear with individual draw-out circuit breakers and switchboards consisting of group mounted, molded case circuit breakers. The main service switchgear and paralleling switchgear will be draw-out construction. Switchboards providing feeder protection for mechanical equipment and electrical feeders for branch circuit panel boards will have group mounted molded case circuit breakers.

   A. Main Electrical switchgear will have the following design features:
      1. Underwriters Laboratory (UL) 1558 construction
      2. Power circuit breakers that comply with IEEE C37.13. Circuit breakers shall be rated for 100% continuous operation of rated load. Operating mechanism shall be mechanically and electrically trip-free, stored energy operating mechanism with manual and electrical charging. All circuit breakers shall have electronic trip units with long time, long time delay, short time, short time delay, instantaneous and ground fault trip adjustments.
      3. Draw-out features to include circuit breaker mounting assembly equipped with racking mechanism to position circuit breaker and hold it in connected, test and disconnected positions.
      4. Mimic Bus arranged in single line diagram format.

   B. Distribution Switchboards will have the following design features:
      1. UL 891 Construction
      2. Molded case circuit breakers that comply with UL 489 standards
      3. Thermal magnetic trip with adjustable magnetic trip for circuit breaker frame sizes 250 amperes and below. AIC Rating shall meet the calculated project requirements.
      4. Electronic trip circuit breakers with field replaceable rating plug. Circuit breaker to have time, long time delay, short time, short time delay, and instantaneous trip adjustments. AIC rating shall meet calculated project requirements.

4.3.1.4 Grounding and Bonding

1. General:

   All electrical equipment including switchgear, distribution switchboards, panel boards, raceway systems and devices shall be grounded in accordance with the National Electrical Code Article 250 – Grounding and Bonding.

   A. Description of System: In general, all electrical equipment (metallic conduit, motor frames, panel boards, etc.) shall be bonded together with a green insulated copper system grounding conductor in accordance with specific rules of Article 250 of the NEC Equipment grounding conductors through the raceway system shall be continuous from main switch ground bus to panel ground bar of each panel board, and from panel grounding bar of each panel board to branch circuit equipment and devices.

B. Equipment Grounding Conductors: All raceways shall have an insulated copper system ground conductor run throughout the entire length of circuit installed within conduit in strict accordance with NEC. Grounding conductor shall be included in total conduit fill when determining conduit sizes.
C. Redundant Grounding: In general all branch circuits shall be provided with a redundant grounding system through the use of grounding conductors and metallic conduit.
D. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.
E. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Receptacle circuits.
   3. Single-phase motor and appliance branch circuits.
   4. Three-phase motor and appliance branch circuits.
   5. Flexible raceway runs.
F. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete.
G. Provide a separately derived grounding system as required by the National Electrical Code. Bond neutral and ground busses together. Provide a separately derived grounding system for all building electrical services and step-down transformers.

4.3.1.5 <u>Interior Electric Distribution Transformers</u>

1. General:

   Provide dry type transformers sized as required to transform distribution voltage to required voltage needed to supply appliances, and receptacles in dormitories.

   A. General transformer Requirements are as follows: Factory-assembled and tested, air-cooled units for 60-Hz service
      1. Cores: Grain-oriented, non-aging silicon steel.
      2. Coils: Continuous windings without splices except for taps.
      3. Internal Coil Connections: Brazed or pressure type.
      4. Coil Material: Copper.

4.3.1.6 <u>Electrical Panel boards</u>

1. General:
   A. Electrical branch circuit panel boards and distribution panel boards shall be provided for over-current protection of branch circuits required feed equipment, and appliance loads in the new Kitchen/Laundry/Central Plant building.
   B. Distribution and branch circuit panel boards shall comply with NEMA PB 1.
   C. Molded-Case Circuit Breaker (MCCB): Comply with UL 489, with interrupting capacity to meet available fault currents.
   D. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.

E. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front mounted, field-adjustable trip setting.
F. Panel board Short-Circuit Current Rating: Rated for series-connected system with integral or remote upstream over current protective devices and labeled by an NRTL. Include size and type of allowable upstream and branch devices, listed and labeled for series-connected short-circuit rating by an NRTL.

4.3.1.7 <u>Package Engine Generator</u>

1. General
   A. The new generator is expected to be 365 KW serving all supply and exhaust fans in the dorms in the event that there is power loss with ample fuel for a minimum of 24 hours.
   B. Reference to Texas Administration Code, Title 37, Part 9, Chapter 263, Subchapter E, Section §263.50, stating that:
      1. New facilities, new additions, and major renovations to existing facilities shall be equipped with an emergency back-up electrical generator designed to operate both manually and automatically upon interruption of the primary electrical power source. The system shall be capable of operating uninterrupted for a minimum period of one and one half hours without refueling. Back-up electrical power shall be provided for necessary equipment and life safety systems including, but not limited to:
         a. emergency illumination systems;
         b. exit lights;
         c. smoke management systems;
         d. fire detection and alarm systems;
         e. audible communication systems;
         f. security/control systems;
         g. normal ventilation systems required for smoke detection.
2. We propose to connect the supply and return fans from emergency power supply to secure adequate ventilation during emergency cases. The same shall be supplied from the existing generator while the added load is small.

4.3.1.8 <u>Branch Wiring Design Criteria</u>

1. General
   A. Governing Codes Standards and Regulations:
      1. The following codes and standards will be used as part of the electrical design criteria for the project:
         a. Texas Building Code 2010 Edition
         b. Texas Fire Prevention Code 2010 Edition
         c. National Fire Protection Association (NFPA):
            1. NFPA 70-2008 Edition. National Electrical Code
            2. NFPA 70E-2011 Edition. Standard for Electrical Safety in the Workplace
            3. NFPA 72-2007 Edition. National Fire Alarm Code
            4. NFPA 110-2005 Edition. Standard for Emergency and Standby Power Systems
         d. City Design and Construction Standards
         e. Institute of Electrical and Electronic Engineers (IEEE): IEEE-1547 Standard for Interconnecting Distributed Resources with Electric Power Systems.

B. Construction Permitting: following the Authority Having Jurisdiction in the location of the jail for the construction of the Infrastructure Upgrade project.

4.3.1.9 Raceways and Conduit

1. General:

   A. All feeders, branch circuit wiring, and fire alarm systems will be installed in conduit. Conduit concealed in wall and above ceilings will be electrical metallic tubing (EMT). All exposed conduit below 8'-0" AFF will be rigid galvanized steel conduit (RGS). Conduit below grade or in concrete slabs shall be schedule 40 PVC. All EMT fittings shall be steel compression type. All RGS fittings shall be threaded rigid steel.

2. Raceway Installations:
   A. The following are general guidelines for use and installation of raceways:
      1. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
         a. Exposed Conduit: Rigid steel conduit where subject to damage, Type EPC-40- PVC, elsewhere.
         b. Concealed Conduit, Aboveground: EMT.
         c. Underground Conduit: RNC, Type EPC-40-PVC, direct buried.
         d. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFMC.
         e. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.
      2. Comply with the following indoor applications, unless otherwise indicated:
         a. Exposed, Not Subject to Physical Damage: EMT.
         b. Exposed, Not Subject to Severe Physical Damage: EMT
         c. Exposed and Subject to Severe Physical Damage: Rigid steel conduit. Includes raceways in the following locations:
            1. Loading dock.
            2. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
3. Mechanical rooms.
   A. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   B. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   C. Damp or Wet Locations: Rigid steel conduit.
   D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, nonmetallic in damp or wet locations.
   E. Exposed in secure areas below 15 feet AFF – Rigid Steel Conduit
4. Minimum Raceway Size: 3/4-inch trade size.
5. Raceway Fittings: Compatible with raceways and suitable for use and location.
6. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated
7. Direct-Buried Conduit:
   A. Excavate trench bottom to provide firm and uniform support for conduit Minimum depth 36" for service entrance and feeders; 24" for branch circuits.
   B. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished

grade, make final conduit connection at end of run and complete backfilling with normal compaction.

C. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.
D. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.
E. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

4.3.1.10 Conductors and Cables

A. General:
   1. All feeders and branch circuit wiring shall be copper type THWN. Minimum size conductor shall be #12 unless otherwise specified. Conductors size #10 and smaller shall be solid and conductors #8 and larger shall be stranded.
B. Raceway Installations: The following are general guidelines for use and installation of conductors:
   1. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.
   2. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
   3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable

4.3.1.11 Wiring Devices

A. General:
   1. Wiring devices to be provided for this project shall be not limited to the following devices:
      a. Receptacles, receptacles with integral GFCI, and associated device plates.
      b. Twist-locking receptacles.
      c. Receptacles with integral surge suppression units.
      d. Snap switches
      e. Wall-switch and exterior occupancy sensors.
      f. Pendant cord-connector devices.
      g. Cord and plug sets.
      h. Floor service outlets
B. Coordination of equipment connections: Coordinate all cord and plug sets for equipment provided under this project. All final connections to kitchen and laundry equipment shall be per specified equipment requirements. Match all current and voltage requirements of the equipment with the final connections.
C. Wall plates for devices shall be as follows:
      a. Plate-Securing Screws: Metal with head color to match plate finish.
      b. Material for Finished Spaces: 0.035-inch thick, satin-finished stainless steel.
      c. Material for Unfinished Spaces: Galvanized steel.
      d. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations."

4.3.2 - Overall Site Layout:

4.4 Miscellaneous Systems– Controls

Each existing H&V unit is controlled by a single thermostat located in the return plenum. The Packaged H&V unit has an integral controller prewired in the factory. No monitoring currently exists for existing system in case of failure of the system.

A new Building Automation System (BAS) control system is proposed primarily for the purposes of monitoring the new system and alerting personnel in the event of failure in any part of the system.

5.0 Finding & Conclusions

Conditioning the air in the dormitories at the Hutchins State Jail is technically feasible. Based on the observed temperature and relative humidity levels recorded by NOAA and confirmed by the information from the data loggers some means of reducing the temperature of the air supplied to the dormitories will be required to achieve ASHRAE 55. The existing ventilation system is simple and straightforward incorporating only the ability to ventilate and heat the dormitory areas.

Conditioning the air to improve indoor thermal comfort will require that the building envelope be upgraded to meet current energy code requirements.

Replacing the existing uninsulated metal wall panels on the roof and walls will yield significant energy cost savings as well as meet the code requirements.

The two (2) building envelope components that will yield the best reduction in thermal radiation transfer will be the roof and the coating on the wall panels.

If air conditioning was installed in the Hutchins State Jail, it is recommended that it be implemented in accordance with the applicable codes mentioned herein above, while complying with ASHRAE 55-2013 where the threshold of comfort is met for the dorm areas. This would be achievable while saving the maximum energy and operating cost and being less than the arbitrary heat index of 88.

Heating is easily achievable and is currently being performed but cooling is not. Once cooling is introduced to a space designed for heating only, other problems will occur such as sweating on building components, corrosion, mold, mildew, and compliance with the energy code. Therefore, the Hutchins State Jail building envelope will require upgrades to meet the energy code as recommended above.

Since the existing dorm heating equipment cannot provide cooling then the current heating system must be replaced in its entirety. We conclude that the most suitable method of providing conditioned air would be an HVAC system that is efficient and commonly found in industry with new air handlers capable of heating, cooling, ventilating, and filtering the air. A

new air ductwork distribution system will be required. Cooling is achieved by a new chilled water plant with associated pipe Distribution system to the air handlers. Heating is achieved by a new heating hot water plant with associated pipe distribution system to the air handlers.

Additional electrical capacity with new electrical feeders would be required to serve the new HVAC system.

Building Commissioning is the process by which the design, installation, and functionality of the building envelope, mechanical HVAC, and Electrical building systems are verified to ensure compliance with minimum code requirements, construction documents, and the owner's project requirements. As this project is designed to meet ASHRAE standards, the commissioning of the building envelope, mechanical HVAC, and electrical systems should be in accordance with ASHRAE Standard 202 "Commissioning Process For Buildings and Systems".

6.0 Bibliography Page

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Appendix "A"

Appendix "A" C1.01

Hutchins Unit, Dallas, TX

Building Envelope, HVAC, Electrical, & Structural Upgrade Opinion of Probable Cost

10-Sep-15

Hutchins Unit

Category of Operation	Quan	Unit	Cost/Unit	Total
Remove and replace exterior wall panels/insulatio	32,200	SF	$ 50.00	$1,610,000
Remove and replace roof panels	168,000	SF	$ 40.00	$6,720,000
Premium to increase thickness wall/roof panels	200,200	SF	$ 0.50	$100,100
Replace windows	*80*	*EA*	*$ 5,000.00*	*$400,000*
Contingency	*2*	*LS*	*$ 75,000.00*	*$150,000*
Subtotal				**$8,980,100**
Cost increase for location & use			*20%*	***$1,796,020***
Construction Cost for One Dorm				***$10,776,120***
Construction Cost for Four Dorms				***$43,104,480***
Overhead & Profit (Includes Outside Contactor)			*20%*	*$8,620,896*
Outside A/E Design			*10%*	*$4,310,448*
Contingency/Project Overhead/Gen. Admin			*13.50%*	*$5,819,105*
Total Project Cost				**$61,854,929**

Mechanical HVAC

Category of Operation	Quan	Unit	Cost/Unit	Total
Chiller Plant, pumps, cooling tower, controls	1,100	Ton	$ 1,383.00	$1,521,300
Air Handlers total of 18	154,000	CFM	$ 13.00	$2,002,000
Boiler Plant	1	LS	$ 960,000.00	$960,000
Pre Insulated pipe w/HDPE casing 1-1/2" dia	-	Lf	$ 23.00	$0
Pre Insulated pipe w/HDPE casing 2" dia	100	Lf	$ 25.00	$2,500
Pre Insulated pipe w/HDPE casing 3" dia	2,800	Lf	$ 35.00	$98,000
Pre Insulated pipe w/HDPE casing 4" dia	3,400	Lf	$ 40.00	$136,000
Pre Insulated pipe w/HDPE casing 6" dia	4,800	Lf	$ 50.00	$240,000
Pre Insulated pipe w/HDPE casing 8" dia	4,000	Lf	$ 60.00	$240,000
Pre Insulated pipe w/HDPE casing 10" dia	2,000	Lf	$ 80.00	$160,000
Pre Insulated pipe w/HDPE casing 12" dia	-	Lf	$ 100.00	$0
Ductwork, galvanized steel	207,652	Lb	$ 6.00	$1,245,910
Ductwork Insulation	116,285	Sqft	$ 2.50	$290,712
Ductwork, flexible, 6" dia	10,383	Lf	$ 7.24	$75,170
Damper, 12"x12"	48	Ea	$ 100.00	$4,800
Damper, 20"x20"	24	Ea	$ 300.00	$7,200
Grille, alum, 24x24	840	Ea	$ 250.00	$210,000
A/C control system	720	Points	$ 1,000.00	$720,000
Subtotal				**$7,913,592**
Cost Increase for location & use			20%	**$1,582,718**
Construction Cost for HVAC				**$9,496,310**

Category of Operation	Quan	Unit	Cost/Unit	Total
Overhead & Profit (Includes Outside Contactor)			20%	$1,899,262
Outside A/E Design			10%	$949,631
Contingency/Project Overhead/Gen. Admin			13.50%	$1,282,002
	Total Project Cost			**$13,627,205**

Electrical System

Category of Operation	Quan	Unit	Cost/Unit	Total
New electrical feeders, switchgear, transformers	2,500	Amp	$ 220	$550,000
Disel Generator Main	465	KVA	$ 800	$372,000
Subtotal				**$922,000**
Cost Increase for location & use			20%	**$184,400**
Construction Cost for Electrical				**$1,106,400**
Overhead & Profit (Includes Outside Contactor)			20%	$221,280
Outside A/E Design			10%	$110,640
Contingency/Project Overhead/Gen. Admin			13.50%	$149,364
	Total Project Cost			**$1,587,684**

Structural

Category of Operation	Quan	Unit	Cost/Unit	Total
Percent of total Mechanical cost	$13,627,205	%	15%	$2,044,081
	Total Project Cost			**$2,044,081**

Total Project Cost Summary

	Total
Project Construction Cost Total	**$79,113,899**

Estimated Construction Duration

Estimated Construction duration including logistics is approximately eighteen (18) months.

THE COSTS NOT INCLUDED IN THIS CHART ARE SET OUT BELOW:

In addition, there will be an increase in ongoing operational costs. The annual cost to operate the new HVAC system is estimated at $316,422. It will be necessary to employ three full-time employees to maintain and repair the new system, at an annual cost of $111,819. The total annual increase in operational cost is estimated at $428,241. (See Appendix “A”, C1.02). Not included in the construction cost total are the additional electrical capacity upgrades that may be required to the site to serve the new HVAC system. Costs for modifications or replacement of the existing diesel generator, water wells, or well pumping capacity for the chilled water make up are also not included.

Appendix "A" C1.02

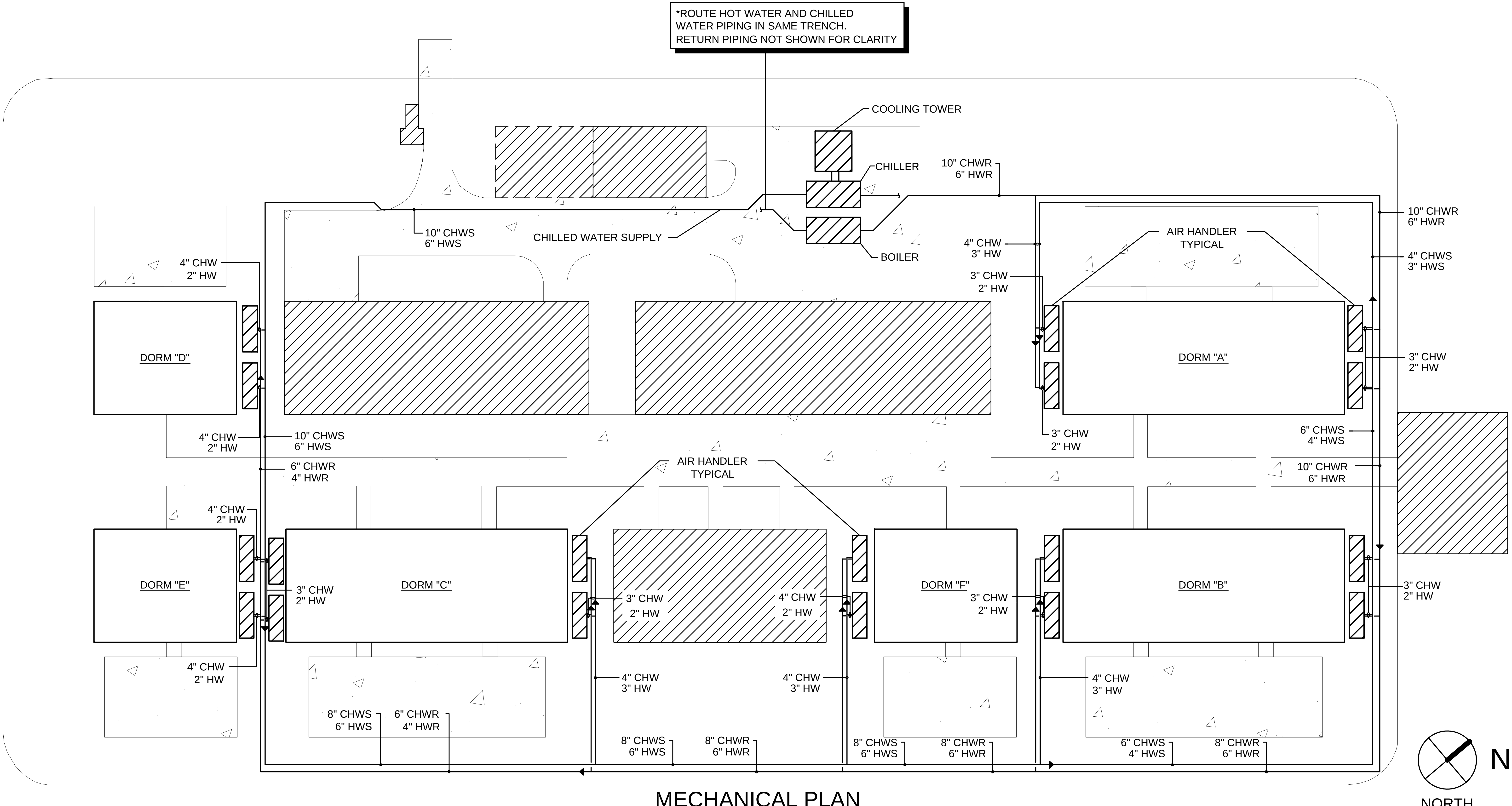
Hutchins Unit, Dallas, Texas

10-Sep-15

Monthly Operating Cost

Month	HVAC Power Cost (.05$/KWH)	Cooling Tower makup water	Chiller Plant Chemical Treatment	Cost for Additional (3) Maintenance Personnel
January	$ 2,609.00	$ 549.19	$ 2,397.15	$ 9,318.25
February	$ 2,776.00	$ 584.34	$ 2,550.59	$ 9,318.25
March	$ 4,606.00	$ 969.56	$ 4,232.00	$ 9,318.25
April	$ 7,050.00	$ 1,484.01	$ 6,477.55	$ 9,318.25
May	$ 13,042.00	$ 2,745.32	$ 11,983.00	$ 9,318.25
June	$ 16,879.00	$ 3,553.00	$ 15,508.44	$ 9,318.25
July	$ 22,119.00	$ 4,656.01	$ 20,322.96	$ 9,318.25
August	$ 22,079.00	$ 4,647.59	$ 20,286.21	$ 9,318.25
September	$ 15,630.00	$ 3,290.09	$ 14,360.86	$ 9,318.25
October	$ 6,602.00	$ 1,389.71	$ 6,065.92	$ 9,318.25
November	$ 3,012.00	$ 634.02	$ 2,767.43	$ 9,318.25
December	$ 2,740.00	$ 576.77	$ 2,517.51	$ 9,318.25
Yearly Subtotals	$ 119,144.00	$ 25,079.61	$ 109,469.64	$ 111,819.00

Other Yearly Costs Items	
Yearly average Stop inspection/Eddy current test cost	$ 10,000.00
Yearly average Chiller repair cost.	$ 24,648.84
Yearly average Tower/Pump repair cost.	$ 28,079.56
Total Annual Cost	**$ 428,240.65**



MECHANICAL PLAN

N.T.S.

Trak Engineering, Inc.
Firm Registration # F-9829
1806 Snake River Rd. Suite D
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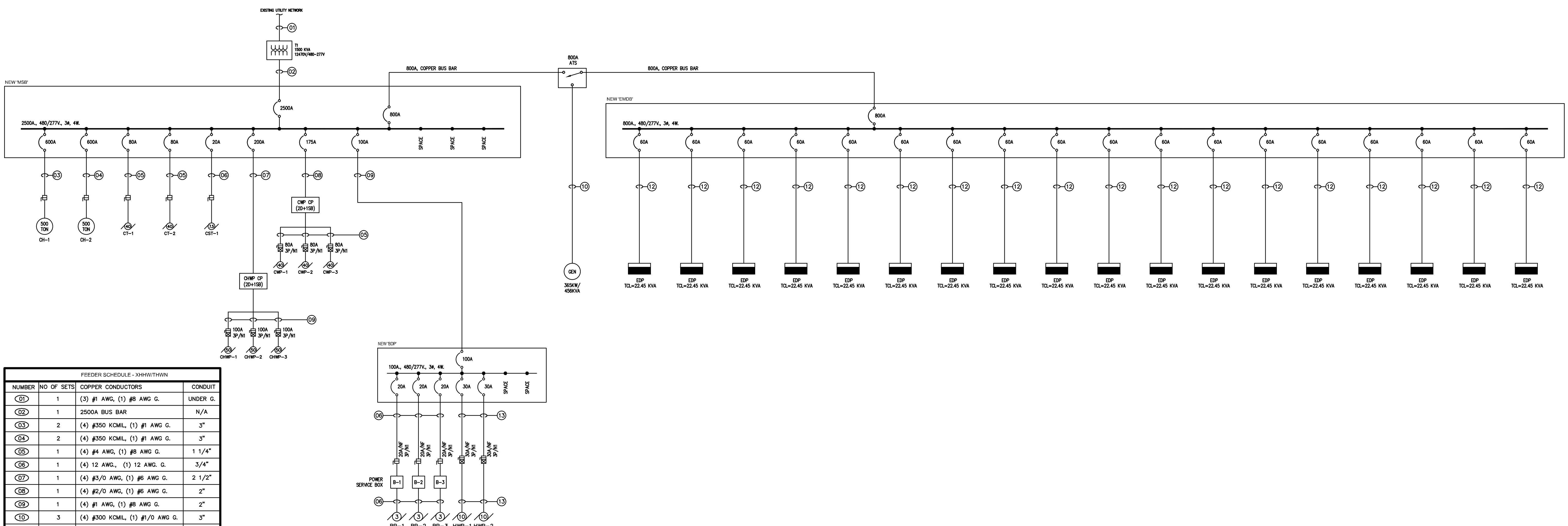
APPENDIX A (08-25-2015)

HUTCHINS UNIT - DALLAS, TEXAS

NOT FOR CONSTRUCTION

M1.01

APPENDIX 354



FEEDER SCHEDULE - XHHW/THWN			
NUMBER	NO OF SETS	COPPER CONDUCTORS	CONDUIT
01	1	(3) #1 AWG, (1) #8 AWG G.	UNDER G.
02	1	2500A BUS BAR	N/A
03	2	(4) #350 KCMIL, (1) #1 AWG G.	3"
04	2	(4) #350 KCMIL, (1) #1 AWG G.	3"
05	1	(4) #4 AWG, (1) #8 AWG G.	1 1/4"
06	1	(4) 12 AWG., (1) 12 AWG. G.	3/4"
07	1	(4) #3/0 AWG, (1) #6 AWG G.	2 1/2"
08	1	(4) #2/0 AWG, (1) #6 AWG G.	2"
09	1	(4) #1 AWG, (1) #8 AWG G.	2"
10	3	(4) #300 KCMIL, (1) #1/0 AWG G.	3"
11	1	(4) #350 KCMIL, (1) #4 AWG G.	3"
12	1	(4) #6 AWG, (1) #8 AWG G.	3/4"
13	1	(4) 10 AWG., (1) 10 AWG. G.	3/4"

Trak Engineering, Inc.
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1806 Snake River Rd. Suite D
Katy, TX 77449
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www.trakengineering.com

ELECTRICAL ONE-LINE DIAGRAM

NTS

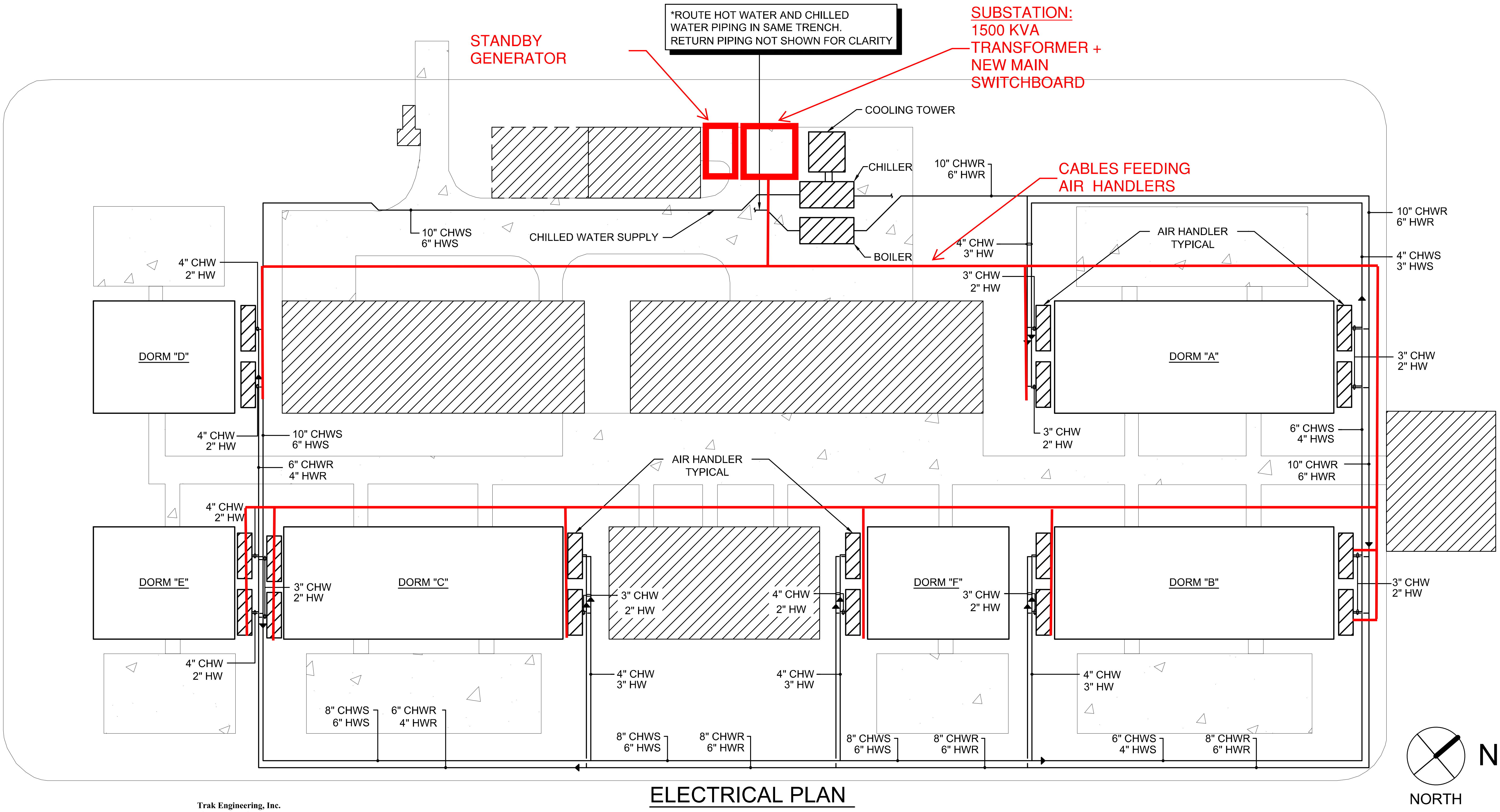
APPENDIX A (08-25-2015)

HUTCHINS UNIT - DALLAS, TEXAS

NOT FOR CONSTRUCTION

APPENDIX 355

E1.01



ELECTRICAL PLAN

N.T.S.

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APPENDIX A (08-25-2015)

HUTCHINS UNIT - DALLAS, TEXAS

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E1.02

APPENDIX 356

Appendix "B"

MCCOLLUM EXPERT STATEMENT OF FRANK TRAKNYAK, PE

1. My name is Frank Traknyak. I am a licensed engineer actively engaged in the practice of engineering in the State of Texas. A true and correct copy of my resume, attached as Appendix B-2, summarizes my relevant qualifications including professional education, certifications, membership in professional associations and experience. I am a Registered Professional Engineer in Texas (#83540) and have been licensed in Texas since 1998.
2. I am the owner and founder of Trak Engineering, Inc., a small engineering corporation. Trak Engineering provides mechanical, electrical, plumbing, and fire protection (MEP) engineering.
3. I have worked for many years designing and supervising the construction of mechanical systems, including heating ventilating and air conditions (HVAC) systems. I have knowledge and experience with the design, components, characteristics, and operation of climate control systems. I am familiar with MEP specs, energy audits, due diligence reports and other applications of regulations and industry standards to building and construction.
4. Trak Engineering, Inc. and PDG Architects (the "TRAK/PDG Team") was tasked with drafting a construction management plan for air conditioning the Hutchins State Jail. My opinions and conclusions are contained in the Hutchins State Jail Study of Indoor Climate Control Modifications ("Hutchins Study").
    a. Documents contained in Section 6 – Bibliography, of the Hutchins Study;
    b. NWS weather data from Ferris Station in Ferris, Texas and Lancaster Airport, Lancaster, Texas
    c. Temperature and humidity data logged inside the Hutchins State Jail from August 25 to October 8, 2014;
    d. On-site visits and observations of the Hutchins State Jail;
    e. Blueprints of the Hutchins State Jail.
5. I also relied on data as reflected in the attached Heating Load Calculations, Cooling Load Calculations, and Energy Usage Calculations, attached as App. B-5.
6. The TRAK/PDG Team has been paid a total of $117,455.00 to draft four (4) Indoor Climate Control Modifications Studies, including a study for the Pack Unit, the Hutchins State Jail, the Michael Unit and the Coffield Unit. The Team was paid $5,000.00 for installation of temperature and humidity sensors in the Pack Unit. My individual time is billed at $250.00 per hour.
7. A list of my publications is included in my resume, attached.

Signed:

____

Frank Traknyak, P.E.

Trak Engineering, Inc.
Mechanical, Electrical, Plumbing, & Fire Protection

"The Art of Engineering Science"

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Katy, TX 77449-7745
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Web: www.trakengineering.com

Frank M. Traknyak, P.E. President & CEO Resume

Summary: - Published Engineer, 8 years with Trak Engineering, Inc. 30 years of engineering, project management, and construction administration, and commissioning experience in University laboratories, Data Centers, teaching hospital and research medical center ; as well as, various types of facilities such as: Utility power plants, Chilled water and boiler plants, waste-to-energy plants, steam-generating plants, Higher Educational institutions, Laboratories, Hospitals, FDA licensed facilities, Medical schools, office buildings, health care, clean rooms, drug manufacturing and process facilities, and military installations.

Qualifications:

- Is highly knowledgeable in with Mechanical Electrical and Plumbing codes and standards including the State building code, Life Safety Code®, NFPA 45 and 99 codes, Mechanical and Plumbing code, and EPA regulations.
- Highly experienced with the computer and programs such as: Microsoft Projects, Word, Excel, PowerPoint, AutoCAD, Revit, Trane trace, Carrier HAP, facility management programs and databases.

Professional Licenses and Certificates Held:

1. P.E. State of Texas, license number 83540
2. P.E. State of Massachusetts, license number 42469
3. P.E. State of Louisiana, license number 32748
4. P.E. State of Colorado, license number PE-40619
5. P.E. State of Arizona, license number, 45406
6. P.E. State of New Mexico, license number, 17797
7. P.E. State of California, license number, 80982
8. NCEES National Council Record Certificate number 29146
9. Certificate in Plumbing Engineering (CIPE)

Education:

1. Certified Purchasing Official, 2003, Department of Capital Asset Management.
2. Certificate in Management, 2001, University of Massachusetts, Worcester MA
3. Certificate in project Management, 2000, Harvard University, Cambridge MA
4. Bachelors of Science in Mechanical Engineering Technology, 1985, Wentworth Institute of Technology, Boston, MA.

Awards: Efficient building project of the year award. Presented on October 10, 2002 by Energy User News for the electric boiler to gas conversion, fume hood active control system, installation of variable speed drives, and the installation of a campus energy management system.

Publications

1. Laboratory Equipment Magazine February 2006 edition, article titled "Generic Labs Don't Come Cheap" A look at the long term costs of Cookie-cutter designs.
2. Engineered systems Magazine, June 2006 edition, Flexible System design
3. Engineered systems Magazine, September 2006 edition, Laboratory air monitoring
4. Laboratories for the 21st century, In Progress, Best Design Practice Flexible lab design

Professional Organizations Previously Held: ASHRAE, SFPE, NFPA, ASPE

Below is a list and brief description of Projects performed: